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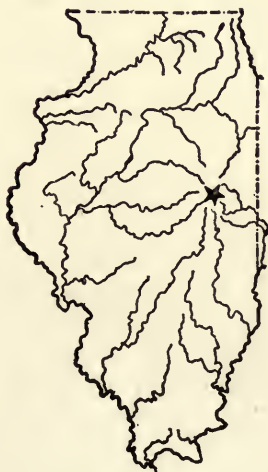
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THE INFLUENCE OF TREES AND CROPS  
ON INJURY BY WHITE-GRUBS

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By STEPHEN A. FORBES  
STATE ENTOMOLOGIST



URBANA, ILLINOIS, FEBRUARY, 1916





## THE INFLUENCE OF TREES AND CROPS ON INJURY BY WHITE-GRUBS

BY STEPHEN A. FORBES, STATE ENTOMOLOGIST

*White-grubs most abundant in the Neighborhood of Trees.*—The fact that our common May-beetles, the parents of most of our white-grubs, fly back and forth each morning and evening between the trees upon which they feed at night and the ground on which they hide by day and in which they lay their eggs, and the further fact that they are never seen to move long distances from place to place, lead to the natural supposition that fields nearest to their food-plants must become most heavily stocked with eggs, and consequently worst injured by grubs when these eggs have hatched. It has, in fact, been frequently noticed that this seems to be the case; and it was for the purpose of getting definite information on the subject, in a form for statement in ratios of frequency or degrees of injury, that I began in 1904 to instruct my field assistants to make collections of white-grubs from fields which were being plowed either in fall or spring. For this purpose they walked behind the plowman, making note of the distance which they traveled in each field, counting the grubs exposed by the plow, and recording at the same time the distance from the field to the nearest trees upon which the May-beetles, the parents of the white-grubs, might be supposed to have fed. Their data concerning abundance of the grubs were recorded in the form of numbers per mile of furrow traveled. The data sheets gave also the locality and date of each collection, the name of the owner of the field, the crop of the year and of the four years immediately preceding, the character and classification of the soil, its level—whether upland or lowland—its condition as to drainage, and the kinds of trees in the neighborhood, as well as the distance of these trees from the margins of the field. Observations and collections of this sort were continued by six of my field assistants as opportunity offered, during the years 1904, 1905, 1907, and 1908. In this time white-grubs were collected from five hundred and forty-nine fields widely scattered thruout central Illinois, with a few fields also in the northern and southern parts of the state. The total distance traveled in this pursuit was a trifle over four hundred and twenty-nine miles, and the total number of grubs of the genus *Phyllophaga* obtained was 12,069. In addition to these, 1187 grubs of the genus *Cyclocephala* were collected, of which, however, no

account can be taken in this discussion, since the beetles of this genus do not feed on the leaves of trees.

One hundred miles of additional travel behind the plow in 1909—77.5 miles in Kane county and 22.5 miles in Marion and Perry counties—proved on analysis to have been done in localities where white-grubs were so few that the data of that year could not be used in this discussion. The northern Illinois fields averaged only eight grubs to the mile, instead of the average of twenty-eight to the mile of the earlier collections, and most of these fields yielded only one or none in the same distance. The southern Illinois fields, altho practically surrounded by woodlands and orchards, gave us only twelve grubs to the mile in 1909, and lacked the contrast of surrounding conditions necessary to the inquiry.

For purposes of classification, my data sheets were assorted into four groups, according to the distances of the fields from the nearest trees—group 1 relating to fields with trees within or on their borders or within less than an eighth of a mile; group 2, to those with trees more than an eighth but less than a fourth of a mile away; group 3, to those with trees more than a quarter of a mile away and less than a half; and group 4, to those with trees half a mile away or more. Two hundred and twenty-four miles were traveled in fields belonging under group 1, with the result that white-grubs of the genus *Phyllophaga* were found at an average rate of 39.17 to the mile; forty miles were traveled in fields of group 2, and in these *Phyllophaga* grubs averaged 17.83 to the mile; in fields of group 3, a hundred and thirty miles were traveled, and *Phyllophaga* grubs averaged 15.94 to the mile; while in group 4, thirty-five miles were traveled, giving 14.4 as the average number of *Phyllophaga* grubs. From this it would appear that fields so situated with reference to fruit, shade, or forest trees that May-beetles might feed within them, on their borders, or within less than an eighth of a mile away, contained two and a fifth times as many white-grubs as those whose nearest trees were between an eighth and a quarter of a mile distant; that they contained practically two and a half times as many grubs as those whose nearest trees were between a quarter and a half mile away; and that they contained two and three quarters times as many grubs as those with trees half a mile away or more.

No attempt was made, in collating these data, to distinguish between the different kinds of trees—a useless task, as the different species of beetles have different preferences as to food; and it is impossible to separate the grubs by species. Ample materials on this subject are contained in a paper entitled “A General Survey of the May-beetles (*Phyllophaga*) of Illinois” (Bull. 186 of this series).

*The Kinds of Crops in which May-beetles Prefer to lay their Eggs.*—The information derived from these collections has enabled me



to distinguish also between the different kinds of crops with reference to the preferences of May-beetles in searching for places to lay their eggs. It has been well established, mainly by the breeding-cage work of John J. Davis, of the U. S. Bureau of Entomology, that our most abundant May-beetles have a three-year life cycle in Illinois. From eggs laid by the beetles in spring or summer, grubs hatch the same season, and then pass thru practically two entire years in the larval or grub stage, and pupate in the third summer or fall after the eggs were deposited. From these pupae the beetles are formed underground, where they pass the winter, coming out at the end of the third full year to lay their eggs.

From this outline it is evident that white-grubs fairly well grown in fall are from eggs deposited the year before, and that if one knows the crop on the field that year he may say with confidence that the parent beetles laid their eggs in that crop. Well-grown grubs seen in spring and early summer, on the other hand, may have come from eggs laid either the preceding year or a year still earlier. To be sure, consequently, of the crop in which the eggs which gave origin to these spring grubs were laid, we must know what crops the field has borne for the *two* preceding years, and can make use only of those fields in which the crops have been the same both years. If such a field has been in corn, for example, for the last two years before the time of observation, it is certain that the parent beetles of the spring white-grubs must have laid their eggs in corn, whatever the age of the grubs. By classifying my data sheets in accordance with these facts, I determined positively the crops in which the eggs were laid that had produced 9664 of our white-grubs, obtained during two hundred and ninety-one miles of travel behind the plow. The following table shows, for each crop in which May-beetles had laid their eggs, the number of miles which my collectors traveled in making their collections, the total number of grubs obtained, and the number per mile.

TABLE SHOWING CROPS IN WHICH EGGS MUST HAVE BEEN LAID FROM WHICH WHITE-GRUBS COLLECTED WERE HATCHED, TOGETHER WITH THE WHOLE NUMBER OF GRUBS COLLECTED, AND THE NUMBER PER MILE FOR EACH SUCH CROP

Crop on ground when eggs were laid	Miles traveled	Number of grubs collected	Number of grubs per mile
Corn	177.1	4342	24.5
Meadow crops, excluding clover	37.5	542	14.7
Pasture	23.5	1991	84.3
Wheat	20.5	1272	62.
Fallow ground	18.5	812	43.3
Oats	9.38	571	60.9
Clover	4.5	134	29.7
	290.98	9664	

From this table we find that more eggs were laid in pastures (84 grubs per mile) than in any other crop; that small grain came next with 61 and 62 per mile for fields which had been in oats and wheat respectively; that fallow land, grown up of course to weeds, largely grasses, was third with 48 grubs to the mile; that clover and corn seemed not far apart in attractiveness to the egg-laying beetles—clover with 30 and corn with 25 grubs to the mile; and that meadow crops (excluding clover) were least sought by the egg-laying beetles—about 15 grubs to the mile in fields which had been in such crops when the eggs were laid.

Additional light is thrown on this subject of a possible choice of crops by May-beetles in which to lay their eggs, by data of quite another description obtained in 1912. This was a year of extraordinary injury by white-grubs in several counties of northern Illinois; and a request for information concerning the injury itself and the previous cropping of the infested fields was sent out (during my absence in Europe) by Mr. Robert D. Glasgow, then of my office staff. Sixty-three replies to this inquiry were received from farmers in Carroll, Stephenson, Winnebago, and Whiteside counties. In thirty-five of these, estimates were given of the injury to fields of corn. The total area of these thirty-five fields was 676 acres, an average of 19.3 acres to the field; and the total estimated injury was \$88.43, an average of \$13.08 per acre. Forty-four of the sixty-three fields reported had been injured by white-grubs. Thirty-five of them were in corn when injured, six in grass, and three in potatoes. The injury was uniformly reported as continuing thruout the season from May or June to September, and it was certain, consequently, that these grubs had hatched from eggs laid in 1911. Of the forty-four injured fields, nineteen were in grass in 1911, nineteen were in oats, three in rye, one in barley, and two in corn. That is, altho 80 percent of the injured fields were in corn in 1912 only 5 percent of them had been in that crop when the parent beetles laid their eggs; and altho only 14 percent of the injured fields were in grass in 1912, 43 percent of them had been in that crop the preceding year. None of the injured fields was in oats, rye, or barley in 1912, but 52 percent of them had been in those crops in 1911. Or, more briefly stated, in 95 percent of the injured fields the eggs had been laid in either small grains or grasses, altho only 14 percent of the injury was in fields bearing such crops.

Turning to the nineteen uninjured fields, on the other hand, I find that fourteen of them were in corn in 1912 and also the same number in 1911, three in grass in both years, one in wheat in both years, one in rye in 1912, and one in oats in 1911. Or, taking corn, grass, and the small grains separately, the number of uninjured fields in each of these classes was the same in both years. The evidence of the predominance of grasses and small grains over corn and other crops

as a lure to May-beetles about to lay their eggs is unmistakable here, and much more emphatic than that obtained from our general collections behind the plow. This is, indeed, what we should expect, as any actual preference of one crop over another would be much more plainly manifest when extraordinary numbers of May-beetles were abroad than when we were dealing with a sparse and widely scattered population.

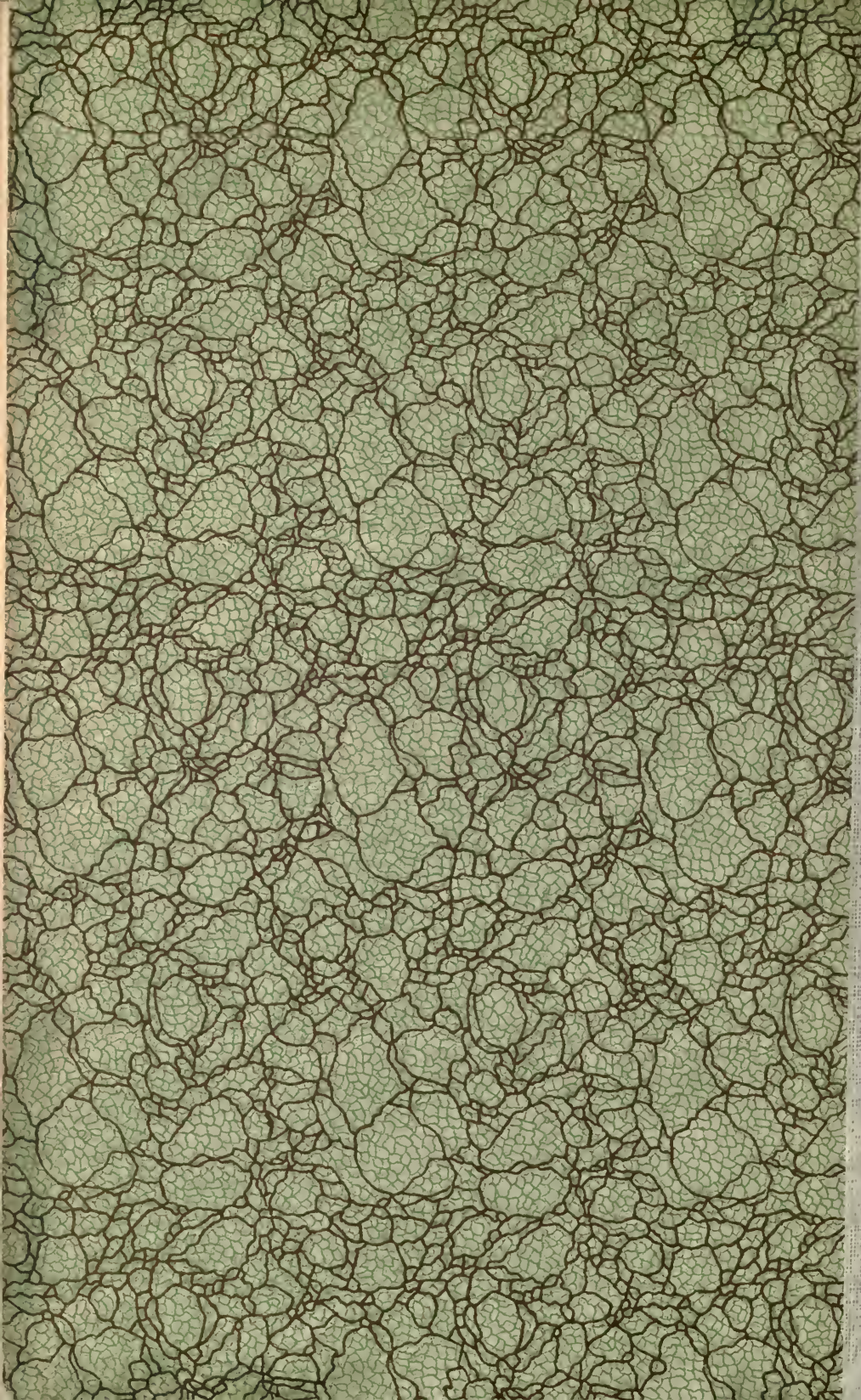
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#### ERRATUM

Page 264, line 22, for \$88.43 read \$8843.

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